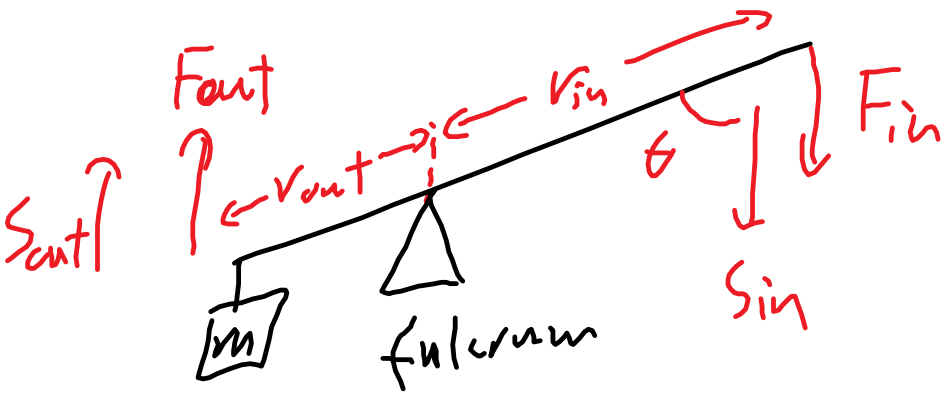
Simple Machines
Lever, Wedge, pulleys, wheel and axel

Ideal Machine: efficiency is 100%
efficiency = Wout/Win x 100%
so ideal Machine Wout = Win

Look at a simple lever



Torque
$\tau = F r \sin\theta$
r is distance from F to rotation point

Ideal machine
$W_{out} = W_{in}$
$F_{out} s_{out} = F_{in} s_{in}$

Mechanical Advantage, $MA = \frac{F_{out}}{F_{in}}$

Ideal Mechanical Advantage $IMA = \frac{F_{out}}{F_{in}} = \frac{s_{in}}{s_{out}}$

eg. Your car has a flat tire. You want to jack up the tire 10cm. The mass of the car is 700kg, you only need to lift 1/4 to change one tire. Each push on the jack lifts the car 1.0 cm while your hand goes through 15 cm.

a) what is the weight of the car that you need to lift?

700x9.81/4=1,716.75 1.7kN

b) what is the total distance your hand pushes through on the jack?

10x15cm= 150cm = 1.5m

(you don't push on the way up)

c) What is the ideal mechanical advantage of the jack?

IMA=sin/sout = 150cm/10cm= 15X

d) what is the minimum force you would have to apply on the jack?

Finsin=Foutsout

Fin= (1,716.75x0.1)/1.5=114.45 = $1.1x10^2$N

MA=Fout/Fin Fin = Fout/MA = 1,716.75/15= 114.45

e) If you actually apply 150N on the jack, what is the mechanical advantage

MA=Fout/Fin = 1,716.75/150=11.445

11X

and efficiency of the jack?
efficiency = Wout/Win x100%
= Foutsout/Finsin x100%
= (1,716.75x0.1/(150x1.5))x100=76.3

76% efficiency

f) where did the lost energy go?
heat and sound due to friction

p206 -210
Q13, 15, 26, 37, 77, 86, 88